FY20 RSM IPR
Ensemble Riprap and Scour Calculator in HEC-RAS
Stanford Gibson (HEC) and David May (CHL)

BLUF: The USACE Riprap software is out of date and does not run on some operating systems. We are incorporating updated USACE scour and riprap design tools in the Hydraulic Design editor of HEC-RAS.

Challenge/Objectives

- **Standardize state-of-practice of USACE scour and riprap design.**
- **Avoid costly failure modes or over-design by automating scour and riprap tools.**
- **Increase analysis efficiency.**
- **Compute scour with an ensemble of appropriate equations to bound the range and communicate uncertainty.**

Approach

We are incorporate these methods into HEC-RAS.

Image from David May

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Stanford Gibson (IWR-HEC)
David May (ERDC-CHL)

We also received guidance and assistance from:
Chris Haring (ERDC-CHL)
David Biedenharn (ERDC-CHL)

Leveraging/Collaborative Opportunities:

The study team worked with MVP on scour and riprap calculations for the American River levee scour project. We worked with the district and ERDC SMEs to formalize the analysis steps and design work flow for the HEC-RAS tools.

HEC Developers and Testers
Anton Rotter-Sieren
Jay Pak

Stakeholders/Partners
USACE-SPK
USACE-MVP
Maricopa County
Everyone who sizes riprap

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Accomplishments/Deliverables

-State-of-Practice Methods Review
-Scour and Riprap Pseudo Code
-Interface Design

-Application Development
(Three –Step Workflow)
1. **Size Riprap**
   (Identify Appropriate Available Rock)
2. **Compute Scour for Launchable Toe**
3. **Calculate Total Rock Volume**

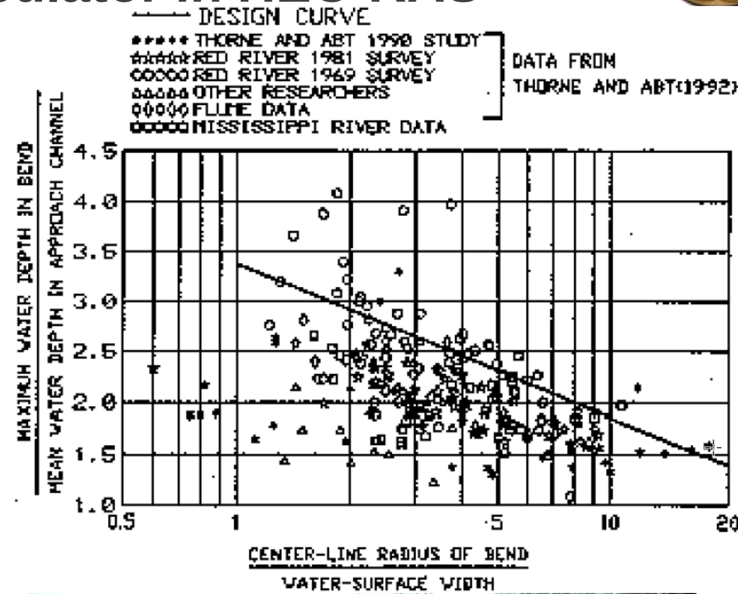
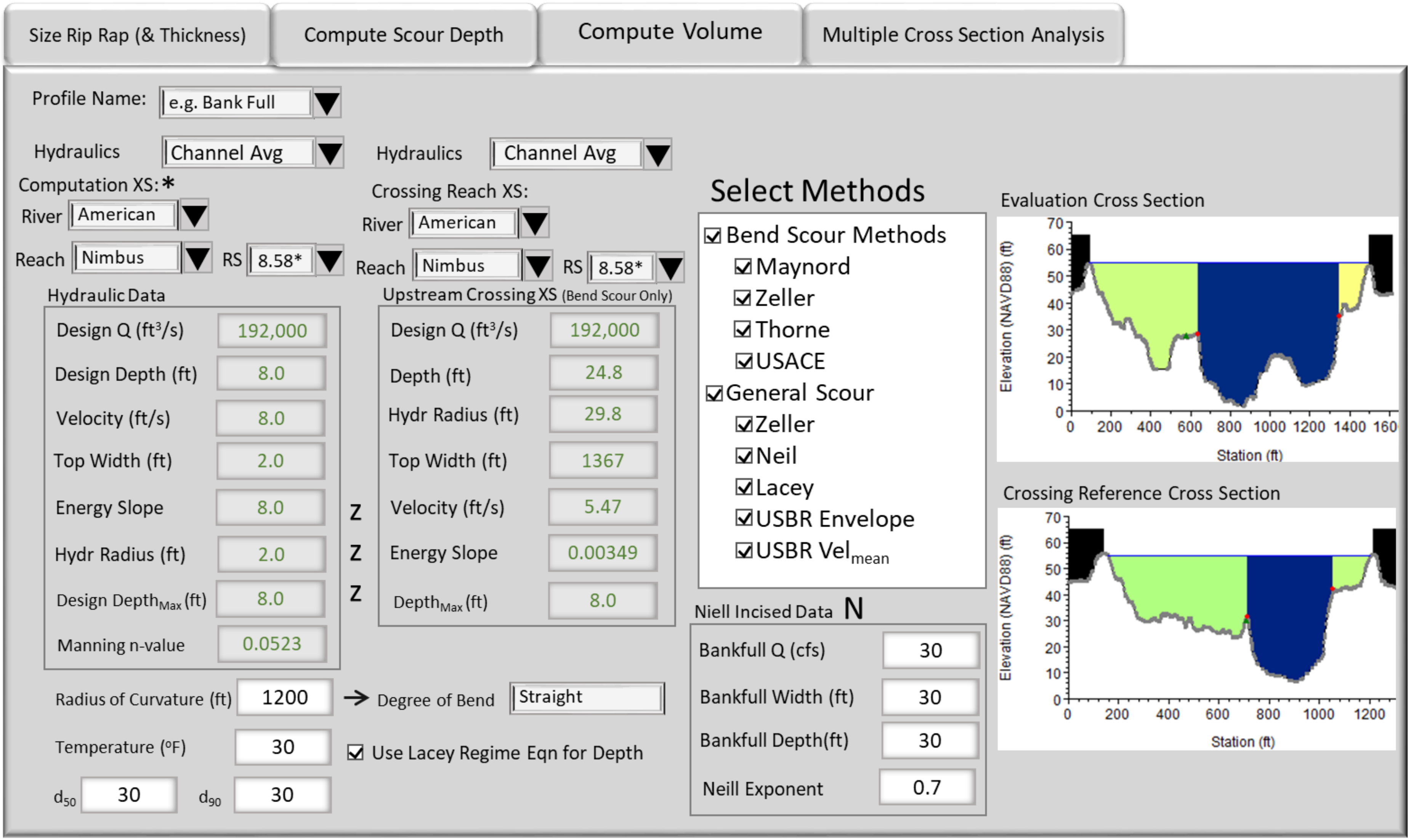
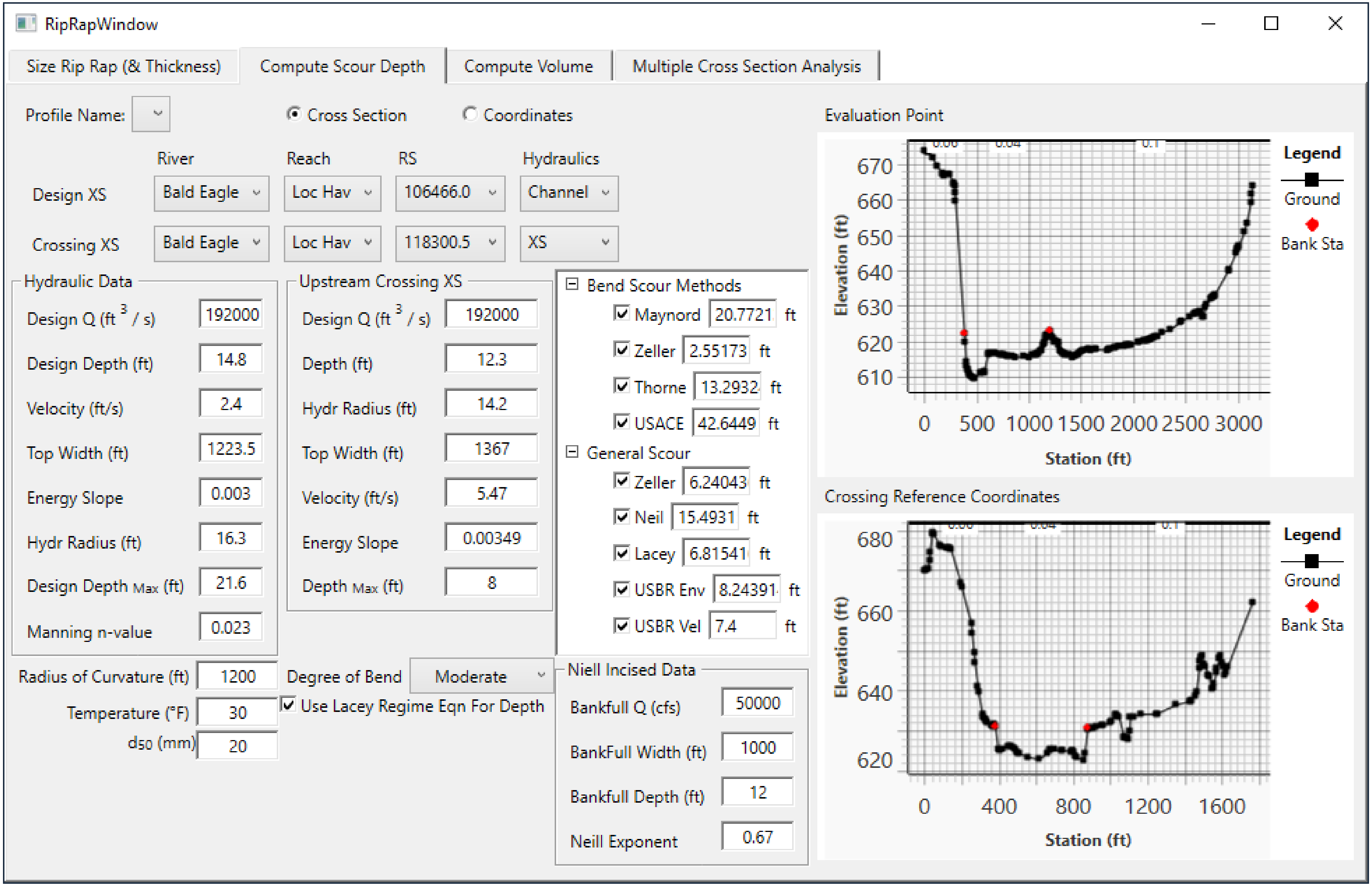


Image from David May

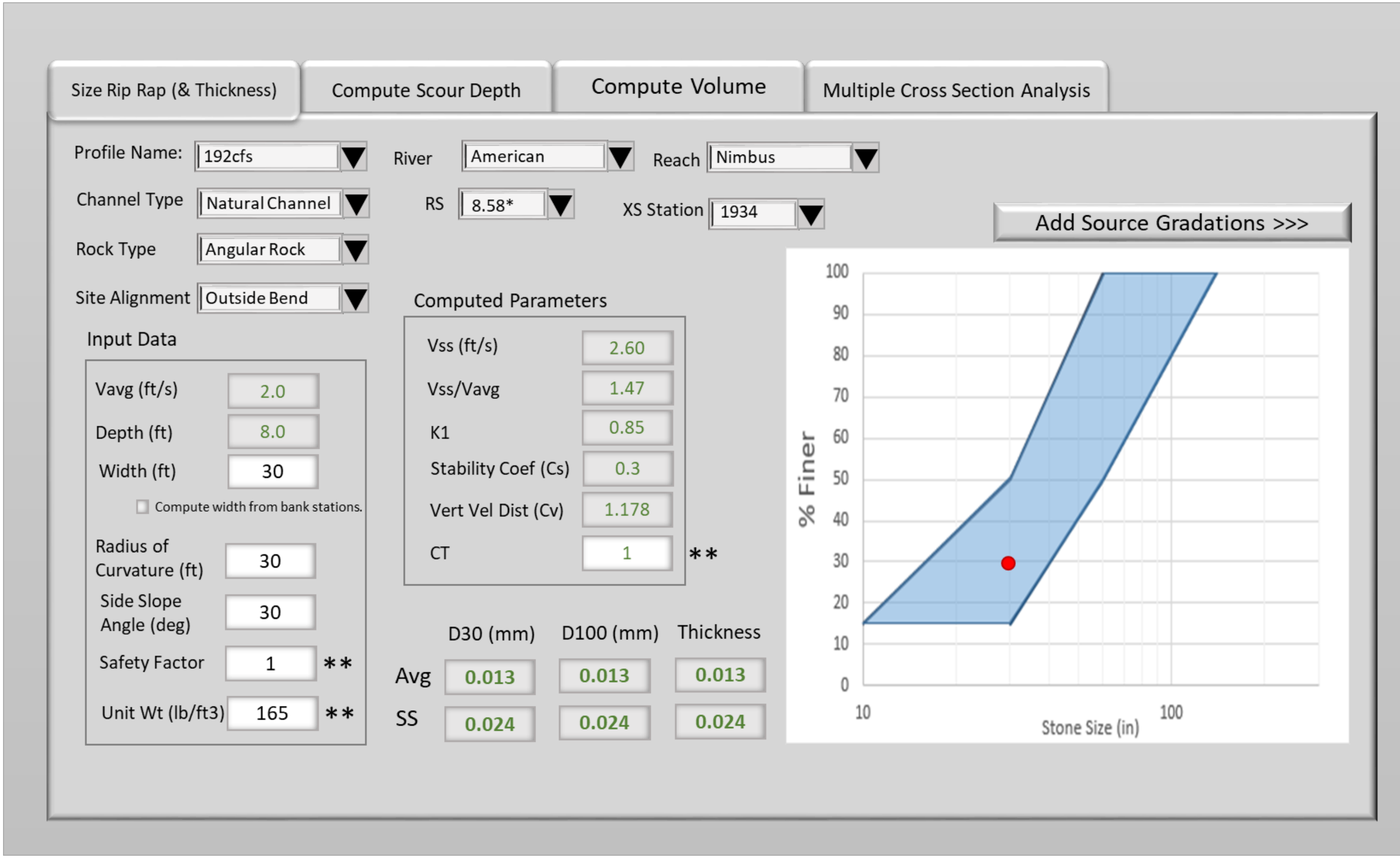
Scour Calculator - Design



Scour Calculator - Interface



Riprap Calculator - Design



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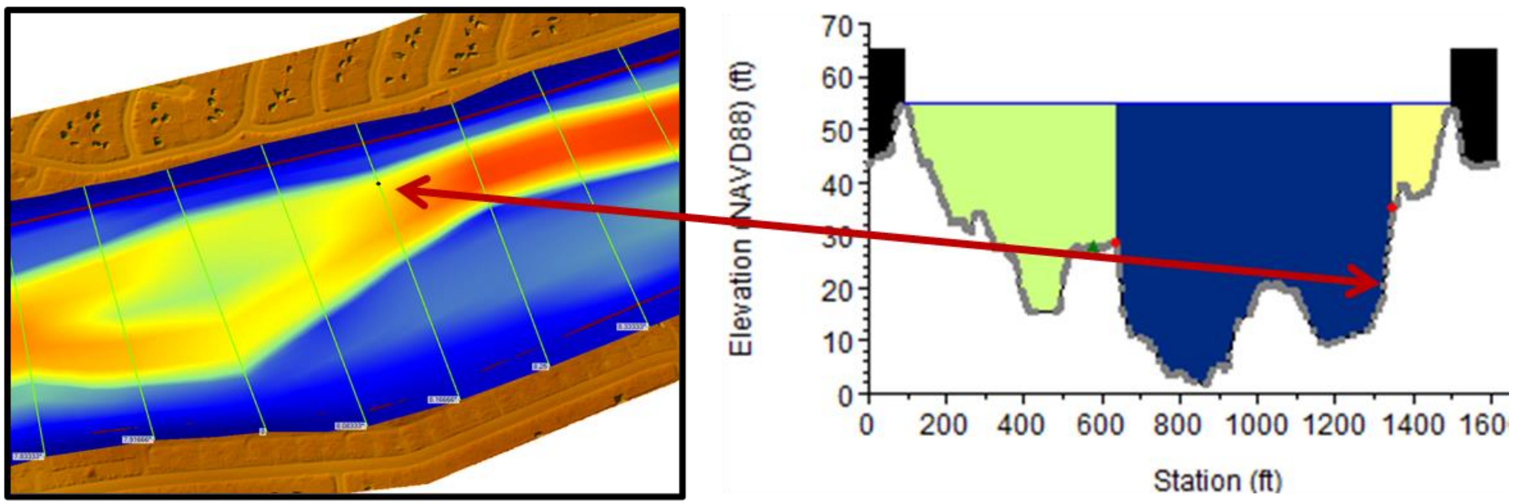
Challenges and Lessons Learned

1. Using 2D (and laterally differentiated 1D) results with classic scour and riprap calculations (based on cross-section averaged velocities) is complicated. It will probably require a research unit to re-derive the equations for local point velocities. For now, we will have to limit the results to 1D simulations or read 2D results along a 1D cut line.



2. HEC developer time during a release cycle can be a little difficult to come by in a release cycle.

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- **Standardize state-of-practice of USACE scour and riprap design.**
  - **With current code out of date and no longer working on some operating systems, Districts are returning to individual spreadsheets and hand calculations. This tool will standardize best practice.**

- **Avoid costly failure modes or over-design by automating scour and riprap tools.**
  - **We spend a lot of money dumping rock. We also save a lot of money in damages placing rock. If we place too much rock or its too big, we waste money. If we place too little or it is too small, protected communities incur damages. Getting this right saves money.**

- **Increase analysis efficiency.**
  - **The rip rap calculations use HEC-RAS output, so it is efficient to build them into the HEC-RAS workflow.**

- **Compute scour with an ensemble of appropriate equations to bound the range and communicate uncertainty.**